REMARKS

The Office Action of September 13, 2005, is discussed in detail below.

Amendments to the Specification

Applicant has amended the specification by reducing the length of the Abstract as requested by the Examiner in Paragraph 1 of the Office Action. Applicant believes that the amended Abstract does not exceed 150 words.

Applicant has also amended the specification by updating the status information of several U.S. Patent Applications that were incorporated by reference in the specification as originally filed. U.S. Pat. Appl. Ser. No. 10/426,321 has now issued as U.S. Patent. No. 6,969,867; U.S. Pat. Appl. Ser. No. 10/384,994 has how issued as U.S. Patent. No. 6,967,344; U.S. Pat. Appl. Ser. No. 10/189,749 has now issued as U.S. Patent No. 6,999,953; and U.S. Pat. Appl. Ser. No. 10/155,527 has now issued as U.S. Patent No. 6,714,954. Applicant has updated the status of each of these applications in the specification.

Applicant has also corrected minor grammatical errors.

Application Informalities

From Paragraph 2 of Office Action

The disclosure is objected to because of the following informalities: the applicant refers to references in the disclosure that are not included in the information disclosure statement PTO-1449 form, which was submitted by the applicant. ...

Applicant has enclosed an information disclosure statement as requested by the Examiner. Applicant disagrees, however, with the assertion by the Examiner that Applicant is required to

either list the references in PTO-1449 or remove the references from the specification altogether. Applicant notes that MPEP 608.01(p) permits applicants for patent to incorporate by reference nonessential subject matter in patent applications. "Nonessential subject matter may be incorporated by reference to (1) patents or applications published by the United States ... Nonessential subject matter is subject matter referred to for purposes of indicating the background of the invention or illustrating the state of the art." The various U.S. patents and patent applications included in Applicant's specification are nonessential subject matter intended to provide the public with background matter helpful to understanding Applicant's invention. Applicant is aware of no requirement that mandates inclusion of patents and patent applications that have been incorporated by reference into the PTO-1449 form. If the Examiner is aware of contrary authority in the MPEP, Applicant would appreciate being alerted to it.

Claim Rejections – 35 USC 102

From Paragraph 4 of Office Action

Claims 1 – 2, 15, 23 and 29 are rejected under 35 U.S.C. 102(e) as being anticipated by the U.S. Patent to Lee et al. (6,862,214).

Lee discloses a phase change memory that improves upon the conventional phase change memory by providing a memory that tolerates greater drive current density through a phase change element. In responding to this rejection, Applicant first reviews the operation of the conventional phase change memory, then describes how the invention of Lee improves upon the conventional phase change memory and finally distinguishes Applicant's invention from the invention of Lee.

In Fig. 1, Lee discloses a conventional phase change memory which includes an array of phase change memory cells, each of which includes a cell transistor CTR, a phase change cell PCC and a resistor R. The cell transistor CTR has a gate connected to a word line WL and the phase change cell PCC is serially connected to resistor R between a drain of the cell transistor CTR and a bit line BL. (Lee, Col. 1, lines 40 – 47) Information is stored in a particular phase change cell PCC by selecting the word line and the bit line to which the cell is connected. Selection of the word line and bit line is accomplished by applying one supply voltage to the word line and a separate supply voltage to the bit line. By providing the supply voltages, a flow of current through the phase change cell PCC occurs and this current writes information to the phase change cell PCC by inducing a change in state. (Lee, Col. 1, lines 47 – 53) The memory states of the phase change cell PCC correspond to amorphous and crystalline states (Lee, Col. 1, lines 15 – 22) and the Joule heating associated with the flow of current provides the energy needed to change from one state to the other. (Lee, Col. 1, lines 23 – 35 and lines 51 – 53)

The problem associated with the conventional phase change memory that Lee seeks to solve is the need to accommodate the level of current needed to drive the change of phase of the phase change cell PCC. Lee indicates that high drive currents are needed and that it is necessary for the cell transistor CTR of each memory cell to have a drive current capacity superior to that of the phase change cell PCC. (Lee, Col. 1, 54 – 56) This requirement is needed so that the full current necessary to drive the requisite change of phase of the phase change cell PCC can be accommodated by the array. If the drive current capacity of the cell transistor CTR is less than that of phase change cell PCC, the current needed to drive the change in phase will damage the cell transistor CTR and render the array inoperable. Accordingly, the invention of Lee teaches

various arrays that provide for greater drive current capacity for the transistor portion of the array. Fig. 2 of Lee presents a typical embodiment of Lee's invention.

In Fig. 2, Lee discloses an array of phase change memory cells arranged in rows where each row includes a plurality of cell transistors (labeled MCTR1 – MCTRN), a plurality of phase change cells (labeled PCC1 – PCCN), and a plurality of resistors (labeled R1 – RN). The array further includes auxiliary transistors (labeled AXTR1 – AXTRN), where each auxiliary transistor connects two neighboring cell transistors. (Lee, column 2, lines 44 – 55.) The array shown in Fig. 2 of Lee achieves the goal of increasing the drive current capacity of the array by providing a series of auxiliary transistors AXTRn. When a bit line is selected with a supply voltage (VCC2 in Fig. 2) and a word line is selected with a supply voltage (VCC1 in Fig. 2), the phase change cell PCC connected to the selected bit line and selected word line receives a drive current that can be used to induce the change in phase needed to write information to the phase change cell PCC. The current flows from the bit line through the selected phase change cell PCC and then through the resistor R before encountering the node at which the resistor R, cell transistor MCTR, and two auxiliary transistors AXTR are connected (Lee, Fig. 2).

In the conventional phase change memory array of Fig. 1, all of the current that passes through resistor R must pass through the cell transistor MCTR and if the current needed to drive the change of phase of the phase change cell is too high, the cell transistor MCTR is overloaded and fails. In the inventive array shown in Fig. 2 of Lee, in contrast, the current that passes through resistor R does not pass exclusively through cell transistor MCTR and instead is distributed over auxiliary transistors AXTR as well as cell transistor MCTR, all of which are activated by providing a supply voltage to the word line. The additional current carrying capacity provided by the auxiliary transistors AXTR allows for greater drive current to pass through phase

change cell PCC while avoiding excess dissipation of the drive current through cell transistor MCTR. "Since the auxiliary transistors of the selected word line are all turned on, and since the auxiliary transistors are connected across the drains of adjacent cell transistors, a parallel current path is established through all of the cell transistors. This results in an increase in drive current through the selected phase change cell PCCm." (Lee, Col. 4, lines 14 – 19)

In the Office Action, the Examiner indicates that the cell transistors (MCTRn) correspond to the security element of Applicant's invention and that these security elements are connected in parallel with the phase change elements (PCCn) and therefore that Lee anticipates Applicant's claimed invention. Applicant believes, however, that the security elements MCTRn and phase change elements PCCn of Lee lack the parallel connectivity recited in Applicant's Claim 1. As indicated above, Applicant acknowledges that the memory array of Lee provides a parallel current pathway. Applicant maintains, however, that this parallel pathway is not available for current that passes from the bit line to the phase change cell PCC, but rather is provided as a parallel pathway for current flow that has already passed through the phase change cell PCC and resistor R of the array shown in Fig. 2 of Lee. The auxiliary transistors AXTR provide a parallel current pathway with respect to the cell transistor MCTR and not with respect to the phase change cell PCC.

Lee teaches no security element connected in parallel to phase change cell PCC. All current passing from the bit line necessarily must pass through phase change cell PCC and resistor R; Lee teaches no parallel pathway for current flow that provides an alternative to current flow through the phase change cell PCC as required by Applicant's Claim 1. Lee does, however, teach a parallel pathway for current flow that provides an alternative to current flow through the cell transistor MCTR. Applicant notes that inclusion of a security element in parallel with the phase

change cell PCC of Lee is contrary to Lee's objective of maintaining the high drive current through phase change cell PCC needed to provide the Joule heating necessary to induce the change of phase required to write information. If a security element were in parallel with the phase change cell PCC of Lee, the current provided by the bit line would be distributed between phase change cell PCC and the security element and this would have the effect of reducing the current provided to phase change cell PCC and would frustrate the goal of driving the change of phase of phase change cell PCC. Since Lee does not teach a combination of a security element and a phase change element connected in parallel, Lee fails to teach each and every element of Applicant's Claim 1 and thus does not anticipate Applicant's Claim 1.

Applicant believes that the rejection of Claim 1, as well as dependent Claims 2 – 29, has been overcome. Applicant respectfully requests removal of the rejection and respectfully submits that the claims are allowable over the references cited by the Examiner.

SUMMARY

The remaining claims in the application are Claims 1 – 29. In view of the above amendments and remarks, Applicant believes that the rejection of Claims 1 – 29 has now been overcome and that these claims are allowable over the reference cited by the Examiner. Applicant respectfully requests withdrawal of all outstanding rejections and respectfully submits that the application stands in condition for allowance. If the Examiner has any questions or suggestions regarding this amendment, the Examiner is respectfully asked to contact Applicant's representative at the telephone number or email address listed below.

Respectfully submitted,

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